(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 067 733 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.01.2001 Bulletin 2001/02

(51) Int Cl.⁷: **H04L 12/28**, H04B 7/185, H04Q 11/04, H04Q 7/38

(21) Application number: **99401686.3**

(22) Date of filing: **06.07.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

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(54) **Scheme for packet allocation in a radiocommunication system**

(57) The invention relates to a method for the allocation of packets on a carrier containing timeslots, comprising the step of defining an interleaving length and an allocation window characterized in that packets are allocated within groups defined by the power needed for the transmission and that the size of groups is at most equal to the interleaving length.

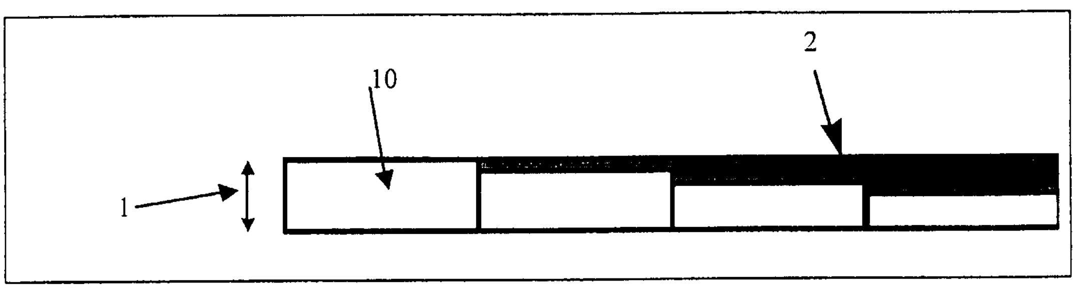

Figure 1

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Description

[0001] The invention relates to telecommunications systems using packet transmission and radiocommunication transfer. More particularly, it is related to a method for allocating packet coming from a packet transmission within a limited timeslot in a radiocommunication system.

[0002] In transmission systems that aim at offering interactive services, it is crucial to define a service quality required for the communication. Since these services are linked with the time response of all the systems, the time delays have to be optimized to ensure this service quality. It is known that there is no perception of time delay when system response times are below a limit defined by the type of service required. For example, phone communications have a limit of about 400ms whereas medical remote systems have a limit of 5ms. The time delay due to the system itself is then crucial.

[0003] In telecommunication and radiocommunication systems, the Bit Error Rate (BER) measuring the quality of the transmission, can be improved by using an error correcting code. In a packet (or cell) transmission, this correcting code can be used in two ways: an individual packet coding or a group coding with packet interleaving. The interleaving method allows reducing the Signal to Noise Ratio (SNR) threshold necessary for reaching the requested BER. Meanwhile, this method has to wait for the whole interleaved packet group in order to decode it.

[0004] In US 5231633, a queueing and dequeueing mechanism for use in an integrated fast packet network, wherein fast packets from differing traffic types are multiplexed with one another through use of a weighted round-robin bandwidth allocation mechanism. Fast packets within a particular traffic type are selected for transmission through use of a head of line priority service (514), a packet discard mechanism, or both. The weighted round-robin bandwidth allocation mechanism functions, in part, based upon a credit counter for each queue group that represents a particular traffic type.

[0005] In US5,905,730, a packet scheduler is disclosed which provides a high degree of fairness in scheduling packets associated with different sessions. The scheduler also minimizes packet delay for packet transmission from a plurality of sessions which may have different requirements and may operate at different transfer rates. When a packet is received by the scheduler, the packet is assigned its own packet virtual start time based on whether the session has any pending packets and the values of the virtual finish time of the previous packet in the session and the packets arrival time. The scheduler then determines a virtual finish time of the packet by determining the transfer time required for the packet based upon its length and rate and by adding the transfer time to the packet virtual start time of the packet. The packet with the smallest virtual finish time is then scheduled for transfer. By selecting packets for transmission in the above described manner, the available bandwidth may be shared in pro-rata proportion to the guaranteed session rate, thereby providing a scheduler with a high degree of fairness while also minimizing the amount of time a packet waits in the scheduler before being served.

[0006] In US5,917,822, a method in accordance with the invention allocates bandwidth, fairly and dynamically, in a shared-media packet switched network to accommodate both elastic and inelastic applications. The method, executed by or in a head-end controller, allocates bandwidth transmission slots, converting requests for bandwidth into virtual scheduling times for granting access to the shared media. The method can use a weighted fair queuing algorithm or a virtual clock algorithm to generate a sequence of upstream slot/ transmission assignment grants. The method supports multiple quality of service (QoS) classes via mechanisms which give highest priority to the service class with the most stringent QoS requirements.

[0007] These systems allow faster packet transmission, with a quality of service, but do not take into consideration the terminal characteristics. They are not fit to a telecommunication system that has a limited power ability, which is one of the problem solved by the invention.

[0008] In a Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA) or frequency division Multiple Access (FDMA) system using an packet transmission, e.g. Asynchronous Transfer Mode (ATM), the communication with a terminal can be sporadic. The power necessary to enable the transmission to the terminal is adjusted following the propagation conditions. These accesses lead to a statistical multiplexing in passband and in power that is controlled by the filling algorithm. The interleaving coding may cause a raise of the time transfer of packets in a given terminal, which is not acceptable if a good service quality is required.

[0009] Resource allocation may be difficult with a interleaving coding for the following reasons:

- Service quality is required, especially for packet transfer;
- Power is identical for the packets belonging to the same group;
- The system should optimize its power and band consumption and avoid complementary or stuffing packets;

[0010] In order to solve these problems, it is possible to use packet interleaving in mono or multi-terminal, a priori or a posteriori packet choice, fixe or variable position in the interleaved packets frame or appropriate carrier filling algorithm.

[0011] The first way to define the classes is based on the a priori knowledge of the emission power for each terminal, independently of the allocation process. At the end of the allocation, packets are interleaved in clusters

with the same length as the interleaving.

[0012] The second way builds the classes after the allocation process, which correspond to an optimal a posteriori class definition. The loss due to power classes is minimized. An additional loss may also occur when the number of allocated packets is not a multiple of the interleaving length.

[0013] It is known that a mono-terminal requires a sufficient number of transmitted packets for an efficient coding in a limited time. The two methods can be combined, depending on the number of packets to be coded. The default method is the interleaving, except when the number of packets is too low. In that case another coding method is used. This solution is not really efficient and needs two decoders in the terminal.

[0014] The invention is related to a method for the allocation of packets on a carrier containing timeslots, comprising the step of defining an interleaving length and an allocation window characterized in that packets are allocated within groups defined by the power needed for the transmission and that the size of groups is at most equal to the interleaving length.

[0015] During the allocation process, packets can come from different terminals.

[0016] Packets are sorted following their power during the allocation and they are spread in groups following their sorting order in order to minimize the power loss in groups. The sorting algorithm can minimize the global power loss during the allocation.

[0017] In a preferred embodiment, packets are interleaved in at least one group.

[0018] This method can be used in a TDMA system, a CDMA system or a FDMA system.

[0019] The invention also relates to an packet transmission receiver, e.g. an ATM receiver, containing storage means and computing means for using the this method.

[0020] The invention is related to multi-terminals using a power class clustering. The power classes enables a packet interleaving with clustering of the packets having a close emission power. Since the interleaved packets are transmitted with the lowest available power terminal, the loss of power due to the packet grouping is minimized.

[0021] Figure 1 shows four packets interleaving. The needed power (1) for the transmission corresponds to the most powered packet (10). The other packets are less powered and therefore lose some of the emission powered (2). The goal of the invention is to find packets with power close enough to minimize this loss.

[0022] Figure 2 shows the general scheme of the Carrier Load Algorithm (CLA)(6). Different packets come in a random order (3). They are recognized following their Skybridge™ Terminal (SKT) and their power (4). The CLA also requires two variables that define the service quality. The first one in well known as the bandwith (Nmax), which gives the number of packets allowable in one Timeslot (TS). The second one gives the power rules defined to avoid interference with other systems. This corresponds to a variable Pmax.. The CLA has to fill the carrier with respect to these two limits, as in (5).

[0023] Figure 3 shows the filling algorithm itself. The first seven packets are already put on the carrier on figure 3a. The next step consists in putting packet number eight between packets six and four, following the decreasing power order (figure 3b).

[0024] The invention consists in filling the carrier by grouping packets with close power and allowing an interleaving coding. Each group corresponds to a power class and its number of packets is the same as the interleaving length.

[0025] In a preferred embodiment, a specific algorithm uses this method in order to fill the carrier the most efficiently way.

[0026] As they are received, the ATM packets are sorted in four queues on the basis of the quality of the associated connection. These queues contain packets from all terminals assigned to the carrier.

[0027] In this embodiment, the algorithm has an allocation cycle of four timeslots and it does the allocation with respect to

- The global number of available codes;
- The global power available for filling the carrier;
- The power differences between codes of the same timeslot. If these powers are too different, the lowest powered codes can lost because of the noise of the highest ones.

[0028] At each stage, the algorithm begins by selecting the packets that need the most important service quality, then spreads them progressively on the first timeslots available in the allocation window while sorting them by decreasing power.

[0029] The first code of the first timeslot therefore contains the most powered packet. When the algorithm decides to put the packet in carrier, it looks for the code and the timeslot when it can be inserted. If the insertion is possible, all the less powered packets are shifted.

[0030] At the end of the allocation process, the power classes correspond to the power needed to transmit the packets on the four timeslots on one code. The power class construction is therefore made dynamically in the allocation process.

[0031] This scheme can be applied to any kind of queuing, e.g. Weighted Fair Queuing, since it only organizes the way packets are put on the carrier, independently from the transfer mode. This method is a complementary process between a scheduler and a telecommunication mode.

[0032] In four packets interleaving, it has been measured that the SNR necessary to ensure a predetermined packet loss rate is lowered by 1dB compared to a mono-packet coding. Conversely, there is a loss due to the clustering that is estimated at 0,3 dB, which leads to a global gain of 0,7 dB in the system.

Claims

1. Method for the allocation of packets on a carrier containing timeslots, comprising the step of defining an interleaving length and an allocation window characterized in that packets are allocated within groups defined by the power needed for the transmission and that the size of groups is at most equal to the interleaving length.

2. Method for the allocation of packets on a carrier containing timeslots according to claim 1 characterized in that packets come from different terminals.

3. Method for the allocation of packets on a carrier containing timeslots according to claim 1 or 2 characterized in that packets are sorted following their power during the allocation and that they are spread in groups following their sorting order in order to minimize the power loss in groups.

4. Method for the allocation of packets on a carrier containing timeslots according to claim 3 characterized in that the sorting algorithm minimizes the global power loss during the allocation.

5. Method for the allocation of packets on a carrier containing timeslots according to claim 1 characterized in that packets are interleaved in at least one group.

6. Application of the method according to claim 1 in a TDMA system.

7. Application of the method according to claim 1 in a CDMA system.

8. Application of the method according to claim 1 in a FDMA system.

9. ATM receiver containing storage means and computing means for using the method of claim 1.

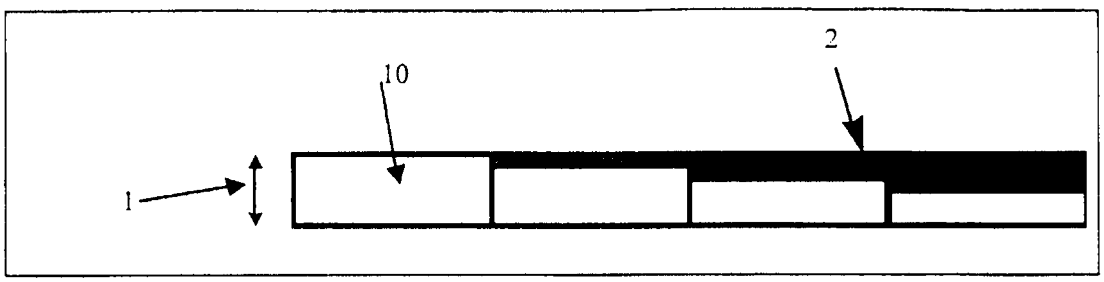

Figure 1

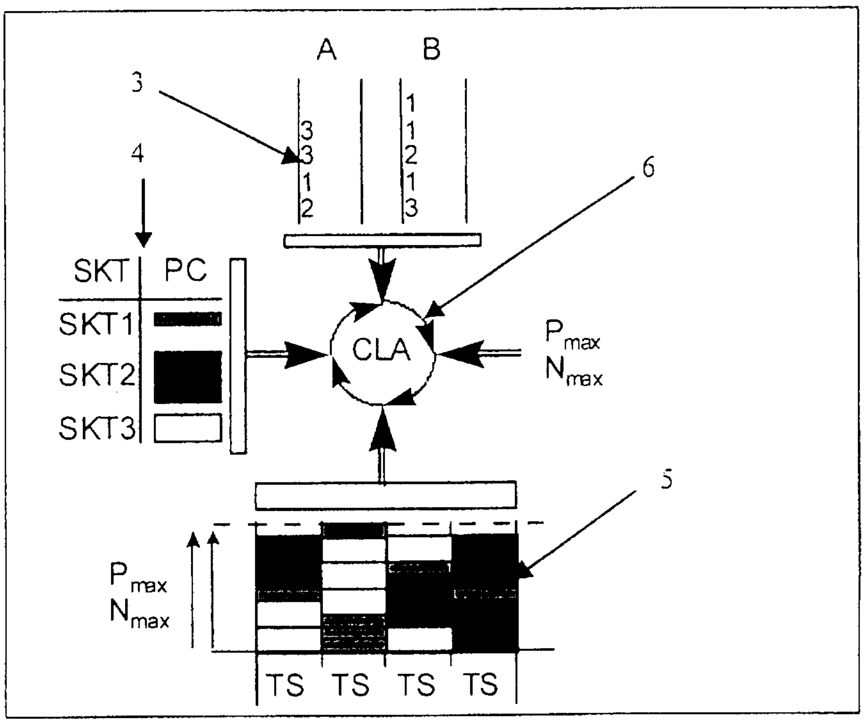

Figure 2

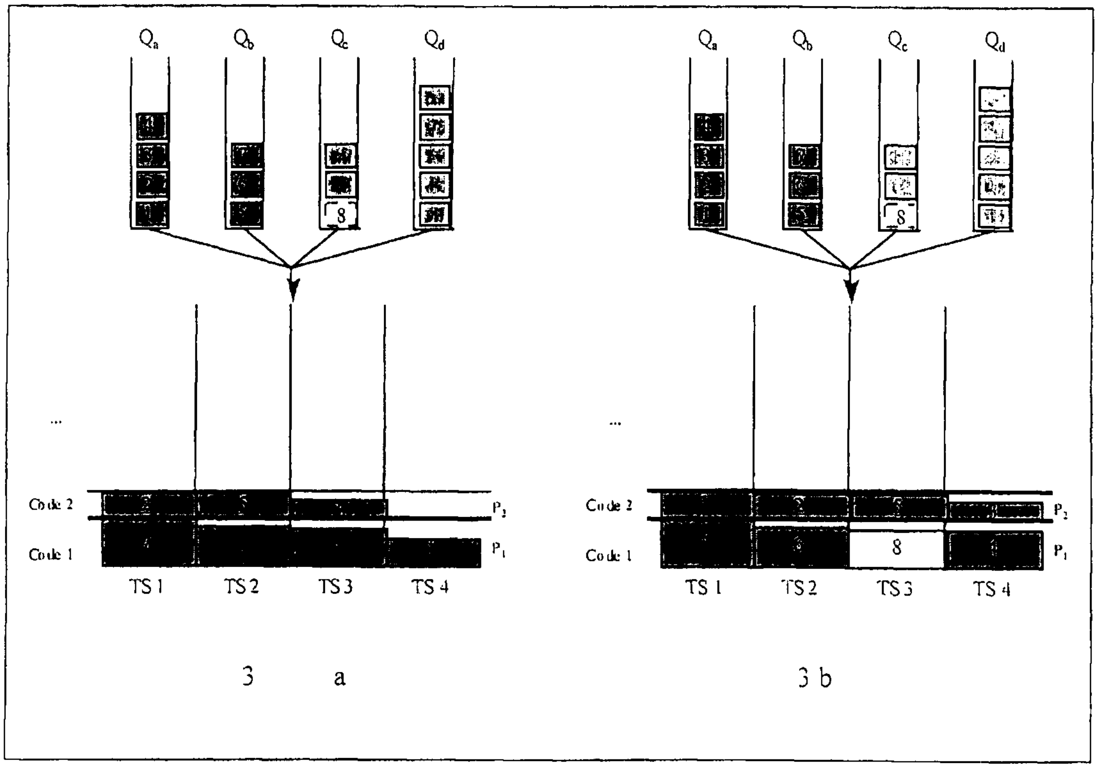

Figure 3

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EUROPEAN SEARCH REPORT

Application Number
EP 99 40 1686

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 December 1999	Vaskimo, K

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X : particularly relevant if taken alone
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